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TITLE

CRIMPING PRESS WITH CONTACT FEED

BACKGROUND OF THE INVENTION

The present invention relates to a crimping press for producing a crimped connection by means of an upper tool and a lower tool, in which the upper tool moves in a linear motion to crimp onto an end of a conductor a crimp contact which can be laid on the lower tool.

The European patent specifications EP 0 884 811 and EP 0 902 509 show a crimping press having a motor and a gear arranged on a stand. Also arranged on the stand are first guides on which a crimping bar is guided. A shaft which is driven by the gear has at one end an eccentric pin, and at the other end a resolver for detection of the rotational angle. The crimping bar consists of a slide which is guided in the first guides, and a toolholder with a force sensor and a holding fork. The slide is loosely connected to the eccentric pin, whereby rotational motion of the eccentric pin is converted into a linear motion of the slide. The maximum stroke of the slide is determined by the upper dead point and lower dead point of the eccentric pin. The toolholder actuates a tool which, together with an anvil forming part of the tool, produces the crimped connection. The tool has a die-carrier with a carrier-head which is loosely connected to the holder fork. Arranged on the die holder are a first crimping die and a second crimping die, which together with the correspondingly formed anvil produce the crimped connection.

A disadvantage of this known device is that the die-carrier which is guided in the tool housing causes forces by friction, or that other forces can arise as a result of jamming, and that the forces distort the measurement of the crimping force.

SUMMARY OF THE INVENTION

The apparatus according to the present invention provides a solution for avoiding the disadvantages of the above-described known device, and creates a crimping press whose upper tool does not generate any frictional forces caused by guides.

In the crimping press according to the present invention, the upper tool with a crimping die is a unit that can be attached directly to the pressing slider. The lower tool with

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an anvil and a contact advance, the contact roll, and the contact feeder are contained in a cassette which forms an interchangeable insert. The crimp contacts are fed to the crimping tool in the form of an arc, which causes the crimping press to be narrow. The lateral space requirements for a crimping press are approximately halved, and the changeover time is substantially reduced. On account of the mechanical separation of the upper tool from the lower tool, the contact belt no longer has to be unthreaded. On the crimping press according to the present invention, the crimping height is programmable (variable dead point). This also dispenses with the manual adjustment of the crimping height and the crimping tool which is necessary on conventional tools.

Integrated into the receptacle for the pressing slider in the upper tool is a force sensor to monitor the crimping force. On conventional tools, this force-monitoring sensor must be built in either above the coupling between the pressing slide and the tool, or under the baseplate of the tool. This has the consequence that as well as the actual crimping forces, other forces (contact advance, cutting forces for separating the contact from the carrier belt, friction, jamming, etc.) are measured along with them. By contrast, in the crimping-press concept according to the present invention, only those forces relevant for evaluating the quality of the crimping are measured. With the arrangement of the upper tool according to the invention, and the innovative measurement of crimping force associated with the arrangement, the true crimping forces can be registered, which in turn allows more accurate statements regarding the quality of crimping.

DESCRIPTION OF THE DRAWINGS

The above, as well as other advantages of the present invention, will become readily apparent to those skilled in the art from the following detailed description of a preferred embodiment when considered in the light of the accompanying drawings in which:

Fig. 1 is a perspective view of a crimping press in accordance with the present invention;

Fig. 2 is a perspective view similar to Fig. 1 with the cassette removed and the upper tool removed;

Fig. 3 is a perspective view of the assembled upper tool from the front;

Fig. 4 is a perspective view of the upper tool in an exploded view;

Fig. 5 is a perspective view of a tool receptacle for the upper tool;

Fig. 6 is a perspective view of the upper tool inserted in the tool receptacle;

Figs. 7 and 8 are perspective views and Fig. 9 is a cross-sectional view of details of a lower tool; and

Figs. 10 and 11 are perspective view and Fig. 12 is a cross-sectional view of details of a tool receptacle with a force-sensing device arranged at the lower end of a pressing slider.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figs. 1 and 2 show a crimping press **CR** according to the present invention. Fig. 2 shows the crimping press **CR** with a cassette **KA** removed and with an upper tool **OW** removed. A motor **MO** drives a gear **GE**. On an output side of the gear **GE** is an eccentric device which converts the rotational motion of the motor **MO** and the gear **GE** into a linear up-and-down motion which can be transmitted to a pressing slider **11** guided by means of guides **FU**.

Fig. 3 and Fig. 4 show details of the upper tool **OW**, which encompasses parts subject to wear such as a wire crimper **1**, an insulation crimper **2**, and a cutting punch **3**. Depending on the crimped contact to be processed, further wear parts and distance plates may be necessary. The wire crimper **1** is bolted tightly to a holder **4**, the remaining wear parts inserted, and the upper tool **OW** closed with a front plate **5**. To adjust the height of the insulation crimping, a distancing piece **6** is exchangeable. The cutting punch **3** is supported in the upper tool **OW** in vertically movable manner, its motion being limited by the dimensions of an oval hole **7** formed in the body.

Provided at the upper end of the pressing slider **11** is an opening **11.1** in which an eccentric pin of the eccentric drive engages, thereby converting the rotary motion of the eccentric pin into a linear up-and-down motion of the pressing slider **11**.

The upper tool **OW** is inserted manually into a tool receptacle **10** arranged at the lower end of the pressing slider **11**, and held against a pin **13** by means of a latch **12**. When tool-changing, the latch **12**, which is pushed upward by a pair of compression springs **12.1**,

is pushed downward by means of an extensible piston **14**. For this purpose, the piston **14** must be extended, and the pressing slider **11** must execute a vertical motion in an upward direction.

Via supporting surfaces **15** of the upper tool **OW**, forces arising during crimping are transmitted to a force sensor **16** located between the receptacle **10** and the slider **11**.

Fig. 6 shows the upper tool **OW** inserted in the fork-shaped tool receptacle **10**, the upper tool **OW** being held by means of a lower fork **10.1** and by means of an upper fork **10.2**. In a crimping operation, the cutting punch **3** actuates a cutter **41** of a lower tool **UW**, by means of which cutter **41** a crimp contact **20** is separated from a carrier belt **21**, and the carrier belt **21** fragmented. The forces arising when this is done do not pass through the force sensor **16**, because the cutting punch **3** can move vertically in the upper tool **OW**, and lies with its extension **3.1** directly against a body **22** of the pressing slider **11**.

As seen in Fig. 2, the cassette **KA**, which is insertable from the rear of the crimping press **CR**, encompasses a contact roll **30** which contains the supply of belted crimp contacts **20**. A contact belt **KO** passes over a tension pulley **32** and, being twisted through 90°, is guided onto the lower tool **UW**. A paper-tape reel **34** is driven via a toothed pulley by a mating gear located in the crimping press **CR**.

Vertically spring-loaded guide bars **33** arranged at both sides serve to insert the cassette **KA** into the crimping press **CR** for cassette changing, the guide bars **33** being guided in guides **33.1** of the crimping press **CR**. On insertion, the cassette **KA** is connected pneumatically and electrically to the crimping press **CR** by means of a quick-change plug connector **36**.

Figs. 7, 8, and 9 show details of the lower tool **UW** comprising a vertical cutter guide **40**, a cutter **41** for separating the crimp contacts **20** from carrier belt **21** and for fragmenting the carrier belt **21**, an anvil **42** for producing a crimped connection, and a contact surface **43** for guiding the crimp contacts **20**. The fragmented carrier belt **21** falls into a waste pipe **44**.

Advancing of the crimp contacts **20** is performed by a swiveling movement of an advancing finger **45**. This finger **45** engages in transporting holes of the carrier belt **21**, and takes the form of a spring-loaded catch which only pushes the contacts **20** forward when it swivels upward. The two end-positions of the swiveling movement can be set with a pair of

setting screws **46.1**, which determine the end-positions of a pneumatic advancing drive **46**. Swiveling and guiding the contact belt **KO** while being advanced is performed by a plurality of guides **47**. These guides **47** are collectively adjustable in the direction of the belt, so that the position of the crimp contact **20** on the lower tool **UW**, and on the anvil **42**, can be determined with precision.

The crimped connection is produced by means of the upper tool **OW** and lower tool **UW**, the upper tool **OW** by means of a linear motion crimping onto an end of a conductor **LE** the crimp contact **20** which can be laid on the lower tool **UW**. This is shown in detail in Fig. 9. The crimp contact **20** attached to the carrier belt **21** has lugs **20.1** for the wire crimp, and lugs **20.2** for the insulating crimp, the lugs **20.1** and **20.2** being plastically deformed by means of the wire crimper **1** and the insulation crimper **2** respectively, and after the crimping operation tightly encircling the wire **LD** and the insulation **LI** respectively. The cutter **41** for separating the crimp contact **20** from the carrier strip **21** comprises a slider **41.1**, with a cutting edge **41.2**, and a non-moving cutting block **41.3** with spring **41.4**. In the crimping operation, the cutting punch **3** moves the slider **41.1** downward against the spring force of the spring **41.4**, and separating the crimp contact **20** by means of the cutting edge **41.2** and by means of a cutting edge **42.1** of the anvil **42**.

Figs. 10, 11, and 12 show details of the tool receptacle **10** arranged at the lower end of the pressing slider **11** with the force-sensing device **16**. The forces arising during the crimping operation are transmitted from the supporting surfaces **15** of the upper tool **OW** to several points on the force-sensing device **16**. In the present example, provided on each side of an upper fork **10.2** and held by screws **16.1** are two collars **16.2**, the crimping forces on either side of the supporting surface **15** being transmitted to the two collars **16.2**. On each side, more or less than two collars **16.2** can also be provided. With their heads, the screws **16.1** hold the collars **16.2**, while with their other ends the screws **16.1** are screwed into the pressing slider **11**.

The force-sensing device **16** consists of a sensor housing **16.3** with a base **16.4** and cover **16.5**, each collar **16.2** having one sensor element **16.6**. The base **16.4** and the cover **16.5** are formed of non-conducting material. The supporting surfaces of the sensor elements **16.6** on the inner sides of the base **16.4** and the cover **16.5** are laminated with an electrically

conducting layer, for example a copper layer. The layer of the base **16.4** is connected by spring contact to the internal conductor of a connecting socket. The casing of the connecting socket is connected directly to the coating of the cover **16.5**. The sensor housing **16.3** has an intermediate layer **16.7** with a thickness less than that of, for example, the sensor element **16.6** in the form of a piezo-ceramic wafer. The forces exerted during the crimping operation on the base **16.4** are transmitted only to the sensor elements **16.6**, and from these to the cover **16.5**. The pressure on the sensor elements **16.6** generates on each sensor element **16.6** an electric charge, which can be measured on the connecting socket of the respective sensor element **16.6**. The separate registering of the crimping forces at, for example, four points enables good information to be given regarding the crimping quality of the crimped connection on the wire, and of the crimped connection on the insulation.

In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiment. However, it should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.